NASA's Systems Engineering Approaches for Addressing Public Health Surveillance Requirements

November 18, 2003
American Public Health Association

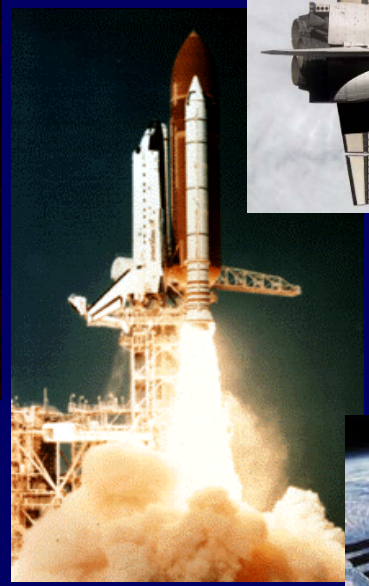
What is Systems Engineering?

Systems Engineering is 21st Century Engineering Practice...

- **An interdisciplinary approach and means to enable the realization of successful systems;**
- **Integrates multiple disciplines and specialty groups into a coordinated team effort;**
- **Provides the framework for a structured development process that proceeds from concept to production to operation;**
- **Considers both the business and technical needs of all stakeholders with the goal of providing a quality product that meets user needs**

NASA's Systems Engineering

Heritage in space mission analysis and design: The end-to-end approach to managing every facet of the extreme engineering required for successful space missions.



NASA's Systems Engineering

Involves:

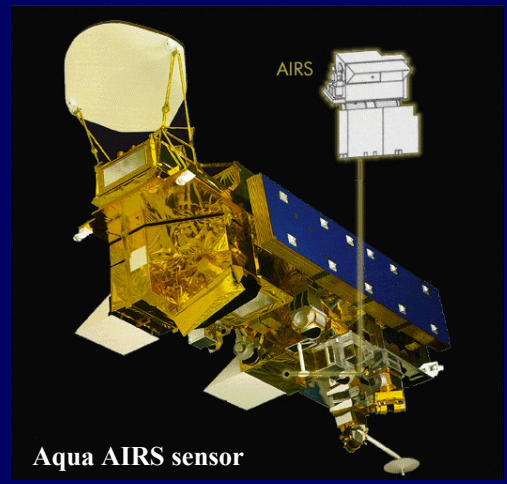
1. Understanding mission objectives;
2. defining requirements to meet objectives;
3. identification of functional, operational and constraint factors that impact each requirement

NASA's Systems Engineering for Public Health

NASA's Earth Science Enterprise is responsible for developing a scientific understanding of the Earth system to enable improved predictions of climate, weather, and natural hazards.

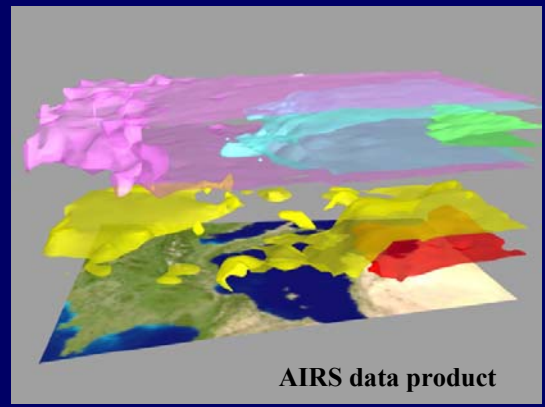

Aqua launch

- **NASA scientists use *remote sensing technology* as a tool to acquire detailed information about the Earth;**
- **Remote sensors collect measurement data on physical characteristics;**



Aqua AIRS sensor

- **These data can be used to characterize, understand and predict environmental phenomena;**


AIRS data product

NASA's Systems Engineering for Public Health

PREMISE: NASA sensor technology, understanding of remote sensing, and knowledge of Earth system science, can be powerful new tools for improved disease surveillance and environmental public health tracking

Earth Science *Applications Goal*

To expand and accelerate the realization of economic and societal benefits from Earth science, information and technology

How is this different from NASA's traditional aerospace engineering?

1. **Applications strategy is built on federal partnerships;**
2. **Applications program is focused on adaptation and adoption of NASA's Earth science data and technology;**
3. **Science and technology requirements are not NASA's, they belong to the partner agency;**

NASA's Systems Engineering for Public Health

Continued...

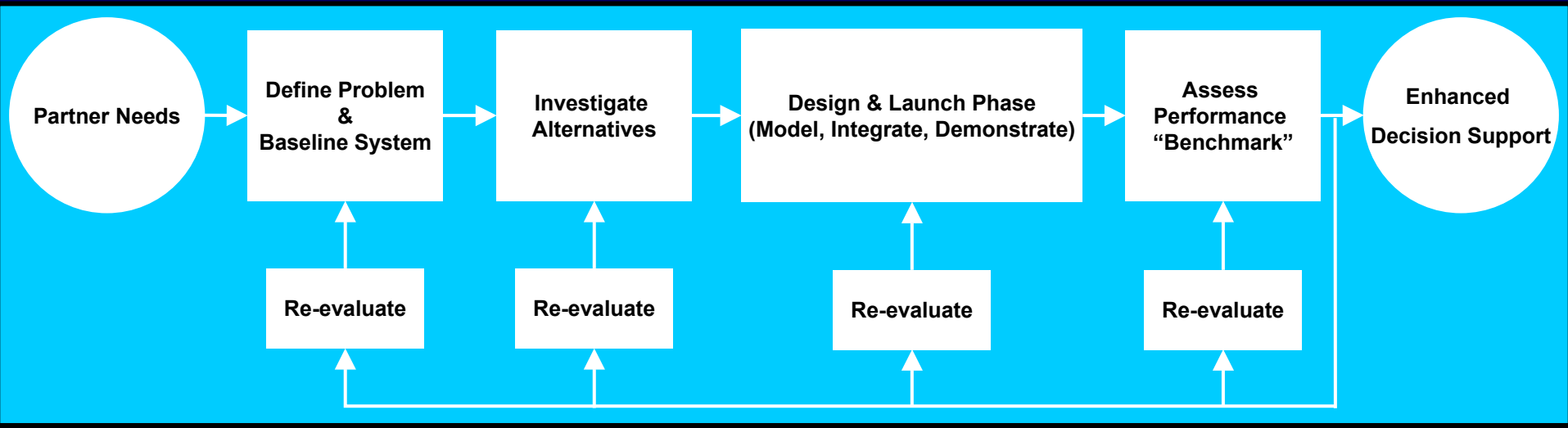
4. **Requirements may be difficult to define if a partner's disease surveillance systems and tools are conceptual and/or are significantly different from what NASA has encountered before;**

5. **NASA is often unfamiliar with a partner agency's mission, operations and organizational culture;**

6. **Disparate disciplines are brought together to work toward a common goal – often for the first time**

NASA's Systems Engineering for Public Health

Framework:

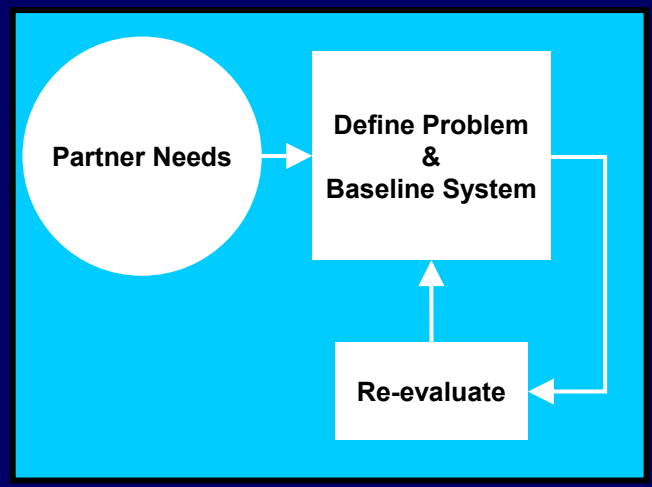


Adapted from Bahill & Gissing (1998)

Approach:

A systems engineering approach facilitates scalable, systemic, and sustainable solutions that contribute to the measurable enhancement of a partner agency's disease surveillance system.

NASA's Systems Engineering for Public Health



Partner Needs & System Requirements

Science/Data

Technology

Integration

- Environmental Public Health Tracking Network (EPHTN)
- ArboNET/Plague Surveillance
- Rapid Syndrome Validation Project (RSVP)
- Malaria Modeling

NASA's Systems Engineering for Public Health

DATA SOURCE

Orbital

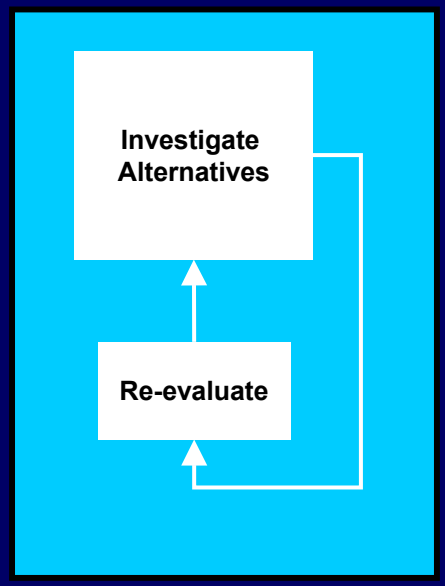
MODIS

AVIRIS

Sub-Orbital

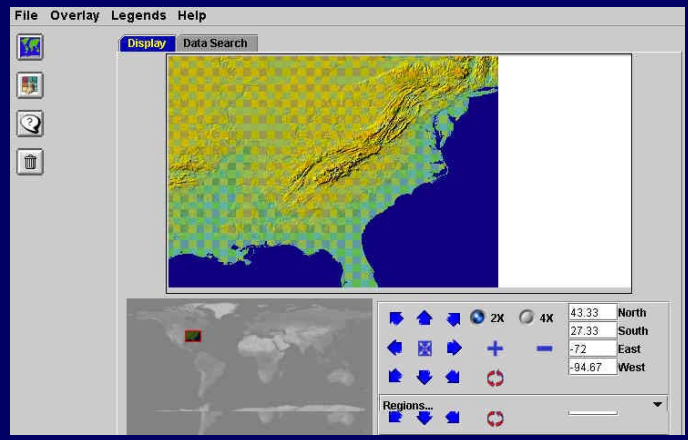
Ground

AERONET



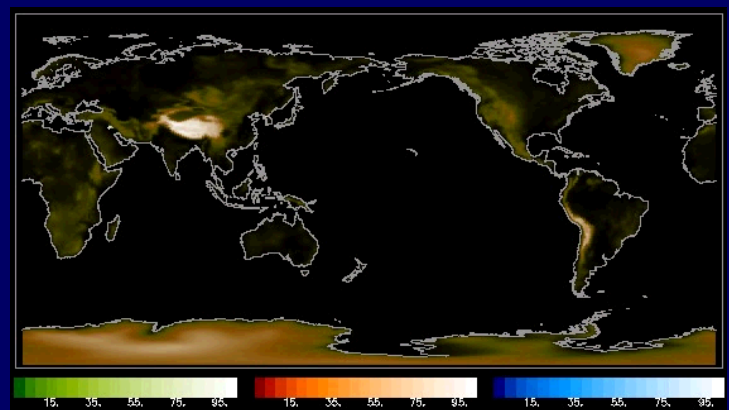
ACCESS & DELIVERY

Information Systems



COMPUTATIONAL TECHNOLOGIES

Modeling



PLUME DISPERSION MODEL

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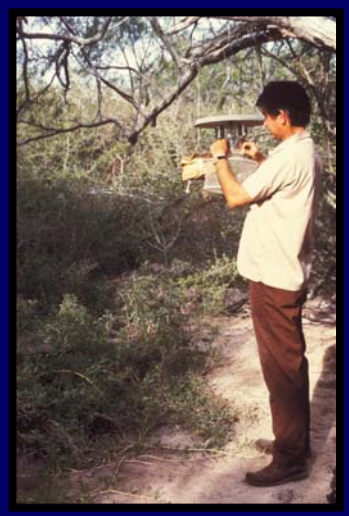
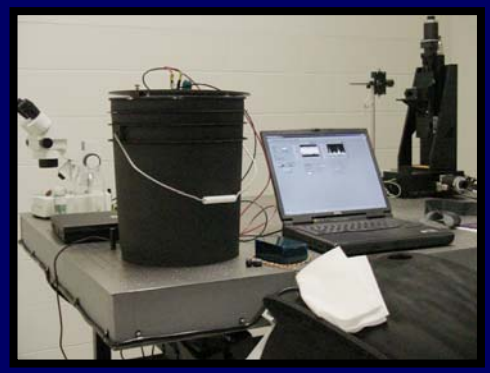
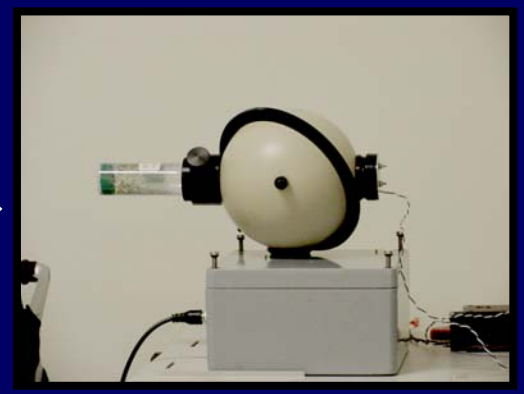
TECHNOLOGY INNOVATION

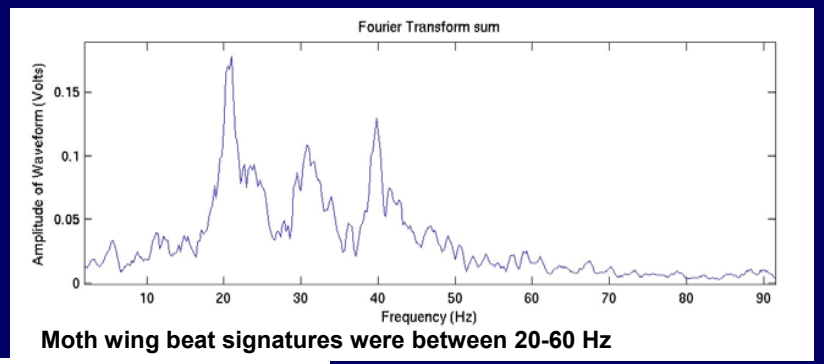
Current Technology



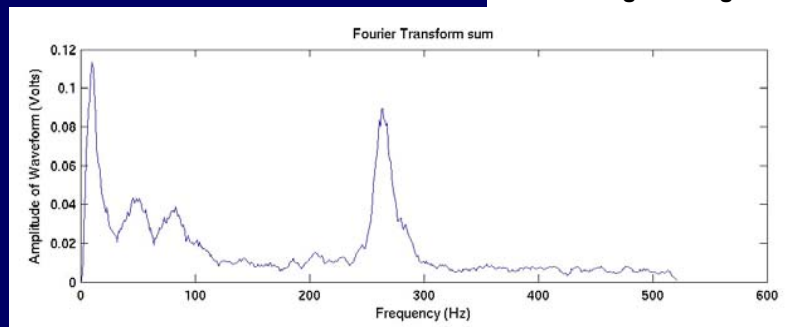


Future Technology





Moth wing beat signatures were between 20-60 Hz



Fruit fly wing beat signatures were between 230-260 Hz

NASA's Systems Engineering for Public Health

DECISION SUPPORT REQUIREMENTS

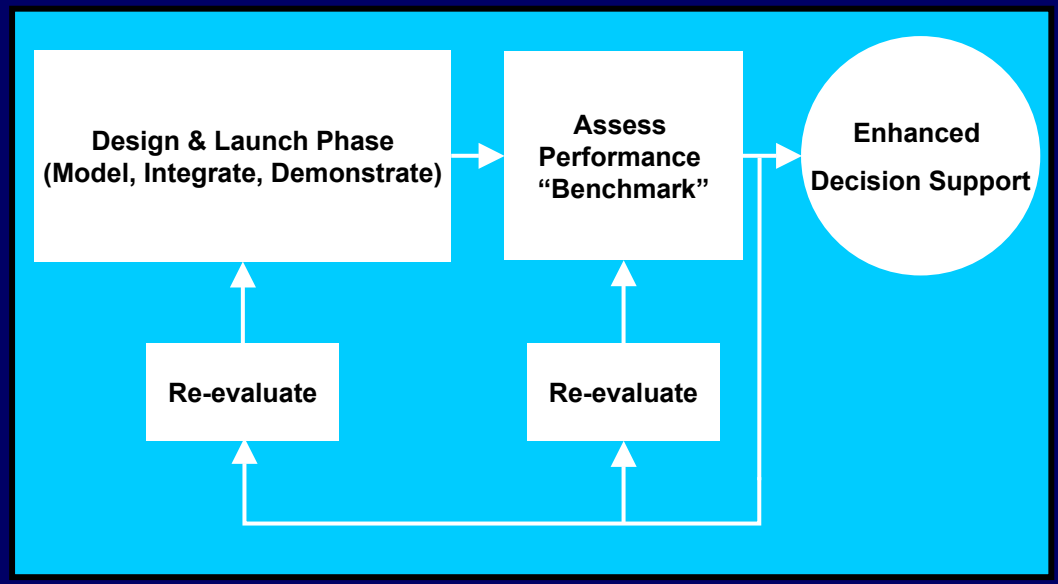
- Data
- Access & Delivery
- Computational Technologies
- Technology Innovation

Environmental Public Health Tracking Network (EPHTN)

ArboNET/Plague Surveillance

Rapid Syndrome Validation Project (RSVP)

Malaria Modeling



Improved Management & Policy

Summary

1. NASA sensor technology, understanding of remote sensing, and knowledge of Earth system science, can be powerful new tools for improved disease surveillance and environmental public health tracking

2. NASA's systems engineering framework facilitates the match between partner needs and decision support requirements
    - Science/Data
    - Technology
    - Integration

3. Goal is systemic and sustainable solutions that contribute to the measurable enhancement of a partner agency's disease surveillance efforts.

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